TABLE 2 Conversion of substrates to biomass, CO_2, organic acids, and H_2 by *R. palustris* during exponential growth[a]

| Substrate | Doubling time (h) | | Yield (mol/mol organic C consumed)[b] | | | | | | | | % C recovery[e] | | % electron recovery[e] | |
| | | | Biomass[c] | | CO_2 | | Organic acids[d] | | H_2 | | | | | |
	WT	NifA*	WT	NifA*	WT	NifA*	WT	NifA*	WT	NifA*	WT	NifA*	WT	NifA*
Fumarate	10.6 ± 1.0[f]	13.2 ± 0.8[f]	62 ± 3	47 ± 2	28 ± 1	29 ± 1	12 ± 2	30 ± 3		18 ± 3[g]	101 ± 5	106 ± 2	104 ± 6	109 ± 3
Succinate	6.5 ± 0.4	8.2 ± 0.5	82 ± 3	67 ± 3	15 ± 1	27 ± 1	0.1 ± 0.0	0.1 ± 0.0		23 ± 1	97 ± 4	94 ± 3	106 ± 4	99 ± 3
Acetate[h]	8.4 ± 0.6	9.4 ± 0.6	88 ± 8	79 ± 4	6 ± 1	17 ± 2	0	0		21 ± 3	93 ± 8	96 ± 5	98 ± 9	99 ± 5
Butyrate-HCO_3^-	8.6 ± 0.4	10.7 ± 1.0	83 ± 6	84 ± 6	-18 ± 4	-11 ± 3	28 ± 3	23 ± 5		11 ± 3	94 ± 5	97 ± 5	97 ± 5	99 ± 8
Butyrate	No growth	32.4 ± 7.6		67 ± 12		6 ± 1		24 ± 2		41 ± 10		97 ± 14		96 ± 15

[a] Unlabeled cultures were grown in minimal medium with NH_4^+ as the nitrogen source. Values are averages from 3 to 5 biological replicates $\pm$ SD based on samples taken during early exponential growth.

[b] Values are normalized for organic C consumed to account for acetate having two carbon atoms, whereas the other substrates have four. Negative signs indicate that there was a net consumption of CO_2, which was made possible by the $NaHCO_3$ supplement.

[c] Moles of biomass were determined from the *R. palustris* 42OL elemental composition (25): $CH_{1.8}N_{0.18}O_{0.38}$ (mole weight, 22.426 g/mol).

[d] Malate was excreted during growth on fumarate, fumarate was excreted during growth on succinate, and acetate was excreted during growth on butyrate.

[e] The percentage of organic carbon and electrons consumed that were observed in products. The sum of the values in biomass, CO_2, and organic acids would equal 100 for full carbon recovery. Electron recovery was based on available hydrogen as described previously (7, 26).

[f] Growth rates during the second growth phase on fumarate.

[g] Calculated by grouping fumarate and malate as a single metabolite [i.e., dH_2/d(fumarate + malate) $\times$ 100/4 carbon atoms]. The H_2 yield from fumarate consumed alone would give a value of 12 ± 2.

[h] The acetate data were previously published (7).